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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/087,416	02/27/2002	Jigish D. Trivedi	MI22-1965	4704

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EXAMINER

OWENS, DOUGLAS W

ART UNIT PAPER NUMBER

2811

DATE MAILED: 01/17/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/087,416

Applicant(s)

TRIVEDI ET AL.

Examiner

Douglas W Owens

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 23 October 2002.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 38-53 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 43, 47-49, 51 and 53 is/are allowed.
- 6) ☒ Claim(s) 38-42, 44, 45, 46, 50 and 52 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- ☒ Notice of References Cited (PTO-892)
- ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 8.
- ☐ Interview Summary (PTO-413) Paper No(s). _____
- ☐ Notice of Informal Patent Application (PTO-152)
- ☐ Other: _____

DETAILED ACTION

Terminal Disclaimer

1. The terminal disclaimer filed on October 23, 2002 disclaiming the terminal portion of any patent granted on this application which would extend beyond the expiration date of 6,417,546 has been reviewed and is accepted. The terminal disclaimer has been recorded.

Specification

2. The title of the invention is not descriptive. A new title is required that is clearly indicative of the invention to which the claims are directed.

The following title is suggested: MOS TRANSISTORS WITH NITROGEN IN THE GATE OXIDE OF THE P-CHANNEL TRANSISTOR.

Claim Rejections - 35 USC § 112

3. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

4. Claims 42 and 44 are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention. While the specification has disclosure for forming a PMOS transistor having nitrogen atoms in the gate oxide, wherein the nitrogen is proximate an interface of the substrate and the gate oxide, there is teaching in the art that it is not desirable to form include nitrogen atoms near the interface of the

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gate dielectric of a PMOS transistor and the substrate. Specifically, US patent No. 5,763,922 to Chau. Chau discloses that in keeping the interface of the gate dielectric and substrate free of nitrogen atoms, hole mobility of a PMOS is improved, and "...hole injection into the gate dielectric layer **260** from channel **270** is substantially reduced as compared with a gate dielectric layer having a nitrided silicon dioxide layer at the substrate/gate dielectric interface." The applicant has not disclosed how holes are prevented from being injected into gate dielectric when nitrogen atoms are included at the PMOS substrate/gate dielectric layer, against the teaching of the prior art.

Claim Rejections - 35 USC § 102

5. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

6. Claims 38, 39, 45, 46, 50 and 52 are rejected under 35 U.S.C. 102(b) as being anticipated by US patent No. 5,763,922 to Chau.

Regarding claims 38, 45 and 46 Chau teaches integrated circuitry comprising a substrate having a plurality of n-channel and p-channel transistors, said transistors comprising a gate (214, 254), a gate dielectric (220, 260) and source/drain regions (216, 256), the gate dielectric of the p-channel transistor comprising an oxide having nitrogen atoms therein and the nitrogen atoms being higher in concentration at only one location as compared to another (Col. 5, lines 1 – 19), the gate dielectric of the n-channel

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transistor being different in composition from the gate dielectric of the p-channel transistors (Col. 1, lines 61 – 63).

Regarding claim 39, Chau teaches integrated circuitry, wherein the gate dielectric of the p-channel transistors comprises silicon dioxide.

Regarding claims 50 and 52, Chau teaches integrated circuitry, wherein the semiconductor substrate is substantially void of nitrogen atoms at an interface with the transistors.

Claim Rejections - 35 USC § 103

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

8. Claims 40 - 42 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chau.

Regarding claim 40, Chau teaches that the gate dielectric of the p-channel transistor comprises a different material from that of the n-channel transistor. Chau does not explicitly teach that the gate dielectric layers are of different thicknesses. It would have been obvious to one of ordinary skill in the art to from the gate dielectrics to have different thicknesses from each other since the different materials would have resulted in different dielectric constants. Accordingly, one of ordinary skill would have compensated by adjusting the thickness of the gate dielectrics.

Regarding claim 41, Chau teaches integrated circuitry, wherein the concentration of nitrogen atoms in the gate dielectric of the p-channel transistors is in the range of 0.1% - 5.0% (Col. 5, lines 16 – 19), which overlaps the claimed range. In the case where the claimed ranges “overlap or lie inside ranges disclosed by the prior art” a *prima facie* case of obviousness exists. *In re Wertheim*, 541 F.2d 257, 191 USPQ 90 (CCPA 1976); *In re Woodruff*, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990).

Regarding claim 42, in so far as being in compliance with 35 USC § 112, Chau does not teach that the location of the nitrogen atoms is proximate an interface of the gate dielectric layer and the substrate. While, there is suggestion by Chau to not place nitrogen atoms near the interface, there is nothing to prevent one of ordinary skill to place the nitrogen atoms near the interface for the purpose of preventing boron atoms in the gate from diffusing to the substrate, as well as preventing boron atoms in the substrate from entering the gate dielectric, since it is known in the art that nitrogen atoms are an effective barrier to boron, a p-type dopant.

Allowable Subject Matter

9. Claims 43, 47 – 49, 51 and 53 are allowed.
10. The following is a statement of reasons for the indication of allowable subject matter: The prior art of record does not teach integrated circuitry, wherein the gate dielectric of the n-channel transistor is void of nitrogen atoms.

Response to Arguments

11. Applicant's arguments with respect to claims 38-41, 45 and 46 have been considered but are moot in view of the new ground(s) of rejection.

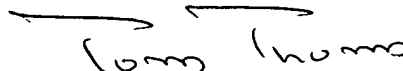
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Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Douglas W Owens whose telephone number is 703-308-6167. The examiner can normally be reached on Monday-Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tom Thomas can be reached on 703-308-2772. The fax phone numbers for the organization where this application or proceeding is assigned are 703-308-7722 for regular communications and 703-308-7722 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

A handwritten signature in black ink that reads "Tom Thomas". The signature is written in a cursive, slightly slanted style.

TOM THOMAS
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2800

DWO
January 13, 2003